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EPA Coalbed Methane Outreach Program Technical Options Series

USING COAL MINE METHANE IN COGENERATION POWER SYSTEMS

3.5 MW gas-fueled standardized cogeneration system at Trigen Energy Corporation facility in Ontario
(Photo courtesy of Trigen Energy Corporation)

ADVANTAGES OF COGENERATION SYSTEMS ARE...

- Can operate at over 80% efficiency using medium quality gas
- Can produce enough on-site electricity to meet the needs of a typical coal mine
- Recovered heat can provide heating and/or cooling for mine facilities
- Can produce thermal energy for nearby industries with boilers or steam turbines
- Use of coal mine methane reduces greenhouse gas emissions

Most coal mines produce enough methane to fuel small-scale cogeneration systems (1-5 MW)

WHY CONSIDER A COGENERATION POWER SYSTEM FOR A COAL MINE?

Many coal mines worldwide drain methane from gob areas (collapsed rock over mined out areas) for safety reasons. Gob wells produce medium quality gas that generally contains 30-80% methane. The gas quality is not suitable for pipeline injection, but mines can use gob gas exceeding 35% methane concentration as fuel for on-site electricity generation. Given their large energy requirements, coal mines can generate electricity on-site and realize significant economic savings, while reducing greenhouse gas emissions.

Coal mine methane has been successfully used to fuel several types of power generating systems, such as internal combustion engines, advanced gas turbines, and cogeneration. Cogeneration systems (also called combined heat and power, or CHP plants), can employ various types of combustion turbines and use waste heat from electricity generation to produce hot air to heat buildings and steam for condensing steam turbines or absorption chiller units. Coal prep plants can use recovered steam for electricity, indirect drying of coal or hot air for direct drying.

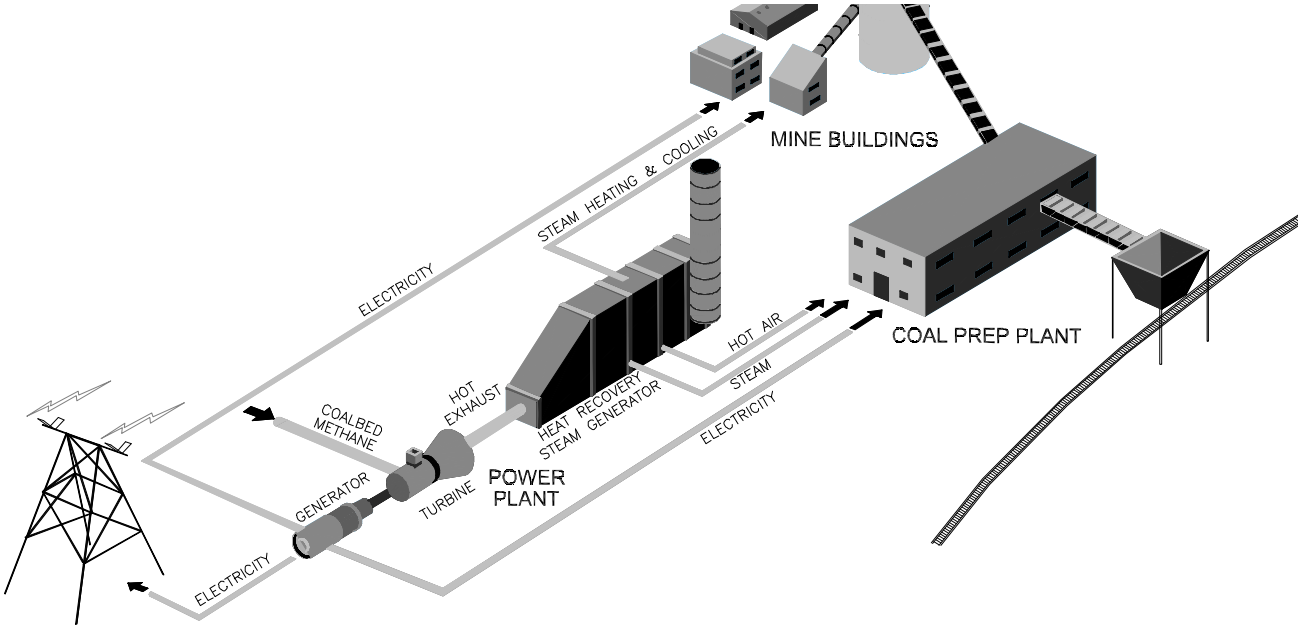
Steam cooling eliminates the use of CFCs and HCFCs

In Europe, cogeneration systems have traditionally been used to produce heat and power for "district heating and cooling" systems serving large-scale residential or commercial complexes. For example, the Zofiowka mine in Poland uses coal mine methane to fuel a cogeneration plant, with the plant supplying heat and power to the mine and the nearby town of Jastrzebie. In addition, several cogeneration systems in Australia use landfill methane as a fuel. Recently, large industries, universities, and hospitals in the U.S. have demonstrated the wide spectrum of applications for cogeneration systems. Plant location is a major factor in determining the economic viability of cogeneration plants at coal mines. Coal mines located in areas with nearby energy-intensive industries such as refineries and chemical, pulp and paper, or metals facilities may be able to export thermal energy to these plants.

The use of coal mine gas helps mitigate emissions of methane, a greenhouse gas. Cogeneration also converts CO_2 into useful energy, further reducing greenhouse gas emissions. Moreover, coal mine methane is a clean burning fuel, and when coupled with cogeneration's efficiency, produces negligible SO_2 and NO_x emissions. For these reasons, independent power producers may find sites near coal mines attractive locations for new gas-fueled cogeneration facilities. In addition, if a coal mine uses steam to cool its buildings, the use of chloroflurocarbons (CFCs) and hydroflurochlorocarbons (HCFCs) could be eliminated, further reducing greenhouse gas emissions.

About 62% of today's cogeneration systems are fueled by gas

While conventional power generation systems operate at 25-45% efficiencies, cogeneration systems can boost efficiency over 80%, depending on the thermal energy use. Cogeneration plants can vary in size from 500 kW up to 500 MW, where systems that produce more heat have higher efficiencies. The ability to sell excess electricity and/or thermal energy makes cogeneration plants a cost-effective source of energy as well as a revenue-generating investment.



Schematic of a cogeneration facility located at a coal mine with a coal prep plant on site

Currently, independent power producers and turbine engineering manufacturing companies are capitalizing on the opportunities resulting from restructuring of the electric industry by filling the needs of companies that require both electrical power and thermal energy. As a result, standard, smaller, semi-mobile cogeneration systems that can supplement a coal mine's electrical and/or thermal needs could be an asset to most gassy coal mines. These packaged systems can be installed in less than two weeks, require little maintenance, and are designed for remote operation. Systems such as these generally range from 1-5 MW in size and installed costs range from $600 to $1000/kW, depending on site specific requirements. A typical coal mine could use a 1-5 MW cogeneration unit to generate electricity for on-site use or sale to other consumers. By self-generating electricity, the mine could avoid electricity purchase costs. In addition, the mine could use the thermal energy to heat and cool surface facilities, such as office buildings, maintenance shops or bath houses.

Power generation equipment vendors are developing small-scale, standard cogeneration systems for coal mine methane applications. One such factory-built system is a 3 MW gas-fueled power unit that can produce up to 3.5 MW of electricity (combined with a 0.5 MW steam turbine) and 30,000 pounds of process steam per hour. A second 4.5 MW combined-cycle system (3 MW gas turbine combined with a 1.5 MW steam turbine) is available for applications where there is little or no use for process steam. Energy efficiency decreases to 35-50%, however, when steam is not fully utilized. Several companies that market these standardized cogeneration systems prefer to own and operate them, and enter into partnerships with fuel suppliers and utilities. Under those circumstances, coal mines would not need the capital to establish a gas-fired power project. Most gassy coal mines drain enough methane required to fuel cogeneration projects of this size (approximately 0.5-1.5 mm cfd).

Typical Small-Scale Cogeneration Systems

Electricity Produced	Steam Produced	Steam Pressure	Maximum Fuel Use	System Efficiency	NO_x Emissions
1.5-4.5 MW	0-30,000 lbs per hour	50 to 420 psig	20-60 mm Btu/hour	50-75%	20-80 ppm

For More Information…

Coal mine operators can take full advantage of cogeneration systems by using them on site for heating or coal drying, or selling thermal energy to a nearby industry. Cogeneration provides low-cost power, steam for heating and cooling buildings, and when fueled by coal mine methane, reduced greenhouse gas emissions.

To obtain more information about converting coal mine methane into energy using cogeneration systems, contact:

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To obtain general information about cogeneration, contact:

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Or contact the EPA's Coalbed Methane Outreach Program for information about this and other profitable uses for coal mine methane:

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